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Source/Driver: (Name & Number from ISP, IAG milestone, Mgmt. Action, Corres. Control, etc.)

Closure #: (Outgoing Correspondence Control #, if applicable)

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Document Subject:

TRANSMITTAL OF THE DRAFT "TECHNICAL MEMORANDUM, MONITORING OF THE 903 PAD/RYAN'S PIT PLUME" – JEL-191-98

KH-00003NS1A

December 10, 1998

Discussion and/or Comments:

Enclosed are five (5) copies of the "Draft Technical Memorandum, Monitoring of the 903 Pad/Ryan's Pit Plume" for joint review by DOE (2 copies) and Kaiser-Hill (3 copies). This technical memorandum provides the basis and technical approach for monitoring the 903 Pad/Ryan's Pit volatile organic compound (VOC) plume to provide data on natural attenuation and to ensure the protection of surface water. Please return your comments by December 16, 1998.

If you have any questions concerning this information please contact Craig Cowdery at extension 2055 or Annette Primrose at extension 4385.

CDC/aw

Attachments:
As Stated

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C. D. Cowdery
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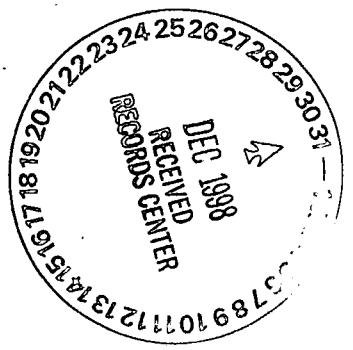
RMRS Records



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Draft Technical Memorandum, Monitoring of the 903 Pad/ Ryan's Pit Plume

RF/RMRS-98-294.UN

December, 1998

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DRAFT
TECHNICAL MEMORANDUM

MONITORING OF
THE 903 PAD/RYAN'S PIT PLUME

DECEMBER, 1998

3

DRAFT TECHNICAL MEMORANDUM
MONITORING OF THE 903 PAD/RYAN'S PIT PLUME

TABLE OF CONTENTS

4

FIGURES

TABLES

5

ACRONYMS

µg/l	micrograms per liter
AHA	Activity Hazard Analysis
Avg.	Average
CERCLA	Comprehensive Environmental Resource, Compensation, and Liability Act
CDPHE	Colorado Department of Public Health and the Environment
CFR	Code of Federal Regulations
cm/sec	centimeters per second
DNAPL	dense nonaqueous phase liquid
DOE	Department of Energy
EPA	Environmental Protection Agency
ER	Environmental Restoration
FO	Field Operations
HASP	Health and Safety Plan
HRR	*Historical Release Report*
IMP	*Integrated Monitoring Plan*
IHSS	Individual Hazardous Substance Site
MCL	Maximum Contaminant Level
mg/kg	milligram per kilogram
OSHA	Occupational Safety and Health Administration
OU	Operable Unit
PARCC	precision, accuracy, reproducibility, completeness, and comparability
PPE	personal protective equipment
QAPD	Quality Assurance Project Description
RAAMP	Radioactive Ambient Air Monitoring Program
RCRA	Resource Conservation and Recovery Act
RFCA	*Rocky Flats Cleanup Agreement*
RFETS	Rocky Flats Environmental Technology Site
RFFO	Rocky Flats Field Office
RFI	RCRA Facility Investigation
RI	Remedial Investigation
RMRS	Rocky Mountain Remediation Services, L.L.C.
SAP	Sampling and Analysis Plan
SID	South Interceptor Ditch
UHSU	upper hydrostratigraphic unit
VOC	volatile organic compound

1.0 INTRODUCTION

The 903 Pad/Ryan's Pit Plume originated from releases that occurred at the 903 Storage Area (Individual Hazardous Substance Site [IHSS] 112) and Ryan's Pit (IHSS 109), previously designated as a part of the former Operable Unit (OU) 2. The 903 Pad/Ryan's Pit groundwater plume was sixteenth in the priority ranking in the September 1998 Environmental Restoration (ER) Ranking. The source areas, Ryan's Pit and 903 Pad, were ranked first and sixth, respectively, in the ER Ranking. The Ryan's Pit source removal was completed in 1996 (RMRS, 1997a) and the 903 Pad Source removal is scheduled for 2001. The primary contaminants in the 903 Pad/Ryan's Pit plume are carbon tetrachloride, trichloroethene, and tetrachloroethene. RFETS agreed on a 1999 milestone for characterizing the plume and installing a groundwater collection and treatment system to protect surface water in Woman Creek.

In 1998, the Rocky Flats Environmental Technology Site (RFETS) program to characterize the 903 Pad/Ryan's Pit plume was approved by Environmental Protection Agency (EPA) and Colorado Department of Public Health and the Environment (CDPHE). The characterization data showed that the contaminated groundwater plume was not affecting surface water and there was evidence of the occurrence of natural attenuation. Both EPA and CDPHE concurred that there was not a need for collection and treatment of contaminated groundwater in the distal end of the plume but that additional groundwater monitoring was required. This technical memorandum provides the basis and technical approach for monitoring the 903 Pad/Ryan's Pit volatile organic compound (VOC) plume to provide data on natural attenuation and to ensure the protection of surface water.

1.1 OBJECTIVE

In accordance with Rocky Flats Cleanup Agreement (RFCA) (DOE, 1996), the objective of 903 Pad/Ryan's Pit VOC plume monitoring is to ensure the protection of surface water.

Corollary Objective: Evaluate natural attenuation of the 903 Pad/Ryan's Pit Plume.

Contaminants from the 903 Pad/Ryan's Pit plume have not been detected in the nearest downstream surface water location. Furthermore, the concentration and total mass of contaminants decreases considerably downgradient from the source area to non-detectable levels in downstream surface water. Based on these results, there does not appear to be a near-term risk to surface water posed by the plume; however, the plume needs to be monitored to ensure that the downgradient extent and downgradient concentrations do not increase to the point where there would be impacts to surface water. Table 1-1 contains the Tier I/II action levels for the contaminants of concern.

Table 1-1 RFCA Tier I/II Surface Water Action Levels for the 903 PAS/Ryan's Pit Plume Contaminants of Concern

Compound	RFCA Action level for Surface Water (µg/l)
Carbon Tetrachloride	5
Cis-1,2-Dichloroethene	70
Methylene Chloride	5
Tetrachloroethene	5
Trichloroethene	5

7

1.2 PROJECT APPROACH

The proposed action includes the installation and periodic sampling of three groundwater-monitoring wells near the leading edge of the 903 Pad/Ryan's Pit Plume. A new well will be installed where Temporary Well 01298 (see Figure 1-1) is shown on the map. Two more wells will be placed downgradient. These wells will be placed in the downgradient locations with the greatest groundwater flux based on additional planned Geoprobe (direct-push sampler) boreholes. The well depths will be approximately 10 to 20 feet deep depending on the location. Geoprobe holes are an inexpensive way to determine the hydrogeology of multiple locations so that wells are not placed in dry areas or areas with low groundwater fluxes. Sampling and reporting activities will be integrated with current activities under the Integrated Monitoring Plan (IMP). Additional details of this approach can be found in Section 3.0.

2.0 PROJECT DESCRIPTION

This section provides a brief project background and data summary along with a description of the hydrogeologic setting and existing site conditions. More detailed information can be found in:

- *Sampling and Analysis Plan, Characterization of the 903 Pad/Ryan's Pit and East Trenches Plumes,* (IT Corp., 1998);
- *Hydrogeologic Characterization Report for the Rocky Flats Environmental Technology Site* (EG&G, 1995);
- *Phase II Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI)/Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Remedial Investigation (RI) Report, 903 Pad, Mound, and East Trenches Area, OU 2,* (DOE 1995), and;
- *Historical Release Report* (HRR) (DOE, 1992).

2.1 BACKGROUND

Two nearby VOC sources contribute to the 903 Pad/Ryan's Pit Plume, the 903 Pad and farther south, Ryan's Pit (Figure 1-1). The 903 Pad area was used to store drums that contained radioactively contaminated oils and VOCs from the summer of 1958 to January 1967. Approximately three-quarters of the drums contained plutonium-contaminated liquids while most of the remaining drums contained uranium-contaminated liquids. Of the drums containing plutonium, the liquid was primarily lathe coolant and carbon tetrachloride in varying proportions. Also stored in the drums were hydraulic oils, vacuum pump oil, trichloroethene, tetrachloroethene, silicone oils, and acetone still bottoms.

Leaking drums were noted in 1964 during routine handling operations. The contents of the leaking drums were transferred to new drums, and the area was fenced to restrict access. When cleanup operations began in 1967, a total of 5,237 drums were at the drum storage site. Approximately 420 drums leaked to some degree. Of these, an estimated 50 drums had leaked their entire contents. The total amount of leaked material was estimated at around 5,000 gallons of contaminated liquid containing approximately 86 grams of plutonium. From 1968 through 1969, some of the radiologically contaminated material was removed, the surrounding area was regraded, and much of the area was covered with clean road base and an asphalt cap. Dense, non-aqueous phase liquids (DNAPLs) are suspected to exist underneath the 903 Pad, as high concentrations of VOCs are present in the groundwater (greater than 1% of the chemical's solubility). RFETS has scheduled remediation of the 903 Pad, including source removal, to begin in 2001.

Ryan's Pit is located approximately 150 feet south of the 903 Pad and is approximately 20 feet long, 10 feet wide, and 5 feet deep. Ryan's Pit was used as a waste disposal site starting in 1969 and for nonradioactive liquid chemical disposal starting in 1971. Use of the pit ceased in 1971. VOCs disposed of at this location included tetrachloroethene, trichloroethene, and carbon tetrachloride. In addition to VOC disposal, paint thinner and small quantities of construction-related chemicals may also have been placed in Ryan's Pit. According to historical data, only liquids were put in the pit. Their containers were either reused or disposed of in other areas (DOE, 1992).

Source removal activities were completed at Ryan's Pit in 1995, including removal of contaminated soils. Along with degraded drums and plutonium-contaminated soils, free-phase tetrachloroethene and motor fuel constituents were found during this removal action. One hundred and eighty cubic yards of source material were removed in this action (RMRS, 1997a).

10

2.2 HYDROGEOLOGIC SETTING

The 903 Pad is located southeast of the Industrial area of RFETS on the flat surface at the southern edge of a pediment. A south facing hillside slopes downward from the 903 Pad to the South Interceptor Ditch (SID) and Woman Creek. Ryan's Pit is located on the hillside to the south of the 903 Pad. In the 903 Pad area, the Rocky Flats Alluvium is 10 feet thick at the northwest corner of the Pad which is near a bedrock high, and 25 feet thick at the southeast corner which is within a bedrock channel. The sitewide geometric mean of the Flats Alluvium hydraulic conductivity is 6×10^{-4} centimeters/second. The Rocky Flats Alluvium is truncated by erosion and does not extend to Ryan's Pit. At Ryan's Pit and further down slope toward Woman Creek, surficial deposits principally consist of clay-rich colluvium and reworked Rocky Flats Alluvium. Caliche is common in both the alluvium and colluvium. Groundwater at Ryan's Pit is between 3 to 10 feet below ground surface. There are numerous slump features in this area and a large scarp face is located between the 903 Pad and Ryan's Pit.

Bedrock in the 903 Pad and Ryan's Pit area is primarily composed of weathered claystone of the Arapahoe and Laramie Formations. In addition, the Arapahoe No. 1 Sandstone subcrops under the alluvium at two locations, west of and southeast of the 903 Pad. The subcropping to the southeast is in the 903 Pad/Ryan's Pit Plume. Because this subcrop is in the path of groundwater flow it could affect the flow and transport of contaminants in this area. The downgradient Geoprobe borings placed in 1998 did not encounter sandstone as a subcropping.

The groundwater contaminant plume from the 903Pad/Ryan's Pit areas is primarily confined to the upper hydrostratigraphic unit (UHSU) which consists of Rocky Flats Alluvium, colluvium, and the weathered bedrock. Groundwater flow is complex and is primarily controlled by bedrock surface features, interactions between geologic units, and variations in saturated thickness. Groundwater flow paths in alluvial materials in the 903 Pad and Ryan's Pit area are relatively well defined by contact seeps with the underlying bedrock materials and by numerous wells. On the hillside, flow is affected by variations in surficial and bedrock topography and heterogeneity within the colluvium and bedrock. Areas of unsaturated colluvium and shallow bedrock are common.

Groundwater flow in the colluvium follows north-south trending preferential pathways cut into the underlying bedrock claystone. One narrow preferential pathway, approximately 150 to 300 feet wide, extends from the 903 Pad south through Ryan's Pit. The areas surrounding these preferential pathways are unsaturated.

The 903 Pad/Ryan's Pit Plume is defined as the lobe of contaminated groundwater that flows southward from these two source areas toward the SID and Woman Creek drainage. The primary plume contaminants are carbon tetrachloride, tetrachloroethene, and trichloroethene. Most of the groundwater does not daylight in this area; however, below the SID there are a number of seeps. The lobe of contaminated groundwater which flows eastward from the 903 Pad is further addressed in the East Trenches Plume Decision Document (RMRS, in progress).

2.3 PREVIOUS INVESTIGATIONS

Subsurface investigations of the 903 Pad/Ryan's Put plume including the OU 2 RCRA Facility Investigation/Remedial Investigation (RFI/RI) were underway as early as 1987. A 1998 investigation was implemented to provide sufficient data to design a groundwater collection and treatment system to protect surface water in Woman Creek. The following information is derived from recent summaries of those investigations (DOE, 1995; RMRS, 1996).

Contaminated groundwater in the 903 Pad and Ryan's Pit area is primarily confined to the UHSU. Fifty-seven VOCs were detected in groundwater of the UHSU; the primary contaminants are carbon tetrachloride, tetrachloroethene, and trichloroethene. Near the 903 Pad, total VOCs in the groundwater are in the 5,000 micrograms per liter (µg/l) range and in the 1,500 to 2,000 µg/l range near the upgradient side of Ryan's Pit. Further downgradient, the total VOC concentration in groundwater ranges from 57,000 µg/l near the downgradient side of Ryan's Pit to 5 µg/l near the leading edge of the plume, approximately 600 feet downgradient. Some contaminated water has been found to the south of the 903 Pad and does not flow through Ryan's Pit. The total VOC concentration in contaminated groundwater plume from the 903 Pad which does not flow through the Ryan's Pit source (flow to the south of the 903 Pad) is estimated to be 5-10 µg/l about 250 feet north of the SID (DOE, 1995, Figures 4.4-3, 4.4-4, and 4.4-5). Because the concentrations are below Tier II Action Levels, this portion of the plume will not be addressed. The concentrations of major constituents of the VOC plume in groundwater from pre-1998 wells located near the 903 Pad/Ryan's Pit downgradient plume boundary are provided in Table 2-1 and shown in Figure 2-1.

Table 2-1. Downgradient Groundwater Concentrations – 903 Pad/Ryan's Pit Plume

Contaminant	Well 6286	Well 6386	Well 1487	Well 23196	Well 01291	RFCA Tier II Groundwater Action Levels
Carbon Tetrachloride	8	ND	460	ND	15	5
Cis-1,2-Dichloroethene	ND	ND	ND	ND	0.2	70
Methylene Chloride	ND	ND	ND	ND	0.5	6
Tetrachloroethene	ND	ND	8	ND	2	5
Trichloroethene	0.8	ND	190	ND	12	5

Note: all values are maximum concentrations (µg/l) from 1996 sampling of monitoring wells; ND indicates not detected or below detection limit (RMRS, 1997b).

The maximum concentrations of many VOC contaminants in the former OU 2 area are located within this plume. The highest concentration of tetrachloroethene (150,000 µg/l) was detected immediately downgradient of Ryan's Pit and occurred with 1,1-dichloroethene at 380 µg/l. A well installed through the center of the 903 Pad had groundwater concentrations of carbon tetrachloride at 20,000 µg/l, chloroform at 39,000 µg/l and methylene chloride at 35,000 µg/l. A well installed at the northeast corner of the 903 Pad detected tetrachloroethene at 14,000 µg/l (DOE, 1995). The apparent extent of the VOC plumes from the 1996 RFCA Groundwater Monitoring Report (RMRS, 1997b) are shown in Figures 2-2, 2-3, 2-4, and 2-5.

Total VOC concentrations in groundwater for the Arapahoe No. 1 Sandstone are approximately 2,500 µg/l adjacent to the west edge of the 903 Pad with concentrations at other locations less than 2 µg/l or non-detect. Although part of the UHSU, the Arapahoe Sandstone does not appear to play a major role downgradient of the source area.

In March and April of 1998, a series of direct push (Geoprobe) borings were installed between the existing wells in Table 2-1 and the SID which is the nearest surface water location (see Figure 2-1). The boreholes were placed in a line parallel to the SID to delineate the leading edge of the plume. The boreholes were completed as temporary wells with a ¾ inch casing and screen intervals of about five feet. Groundwater levels were generally checked within one day of well installation.

12

Sampling and analysis of the groundwater was performed in accordance with the Sampling and Analysis Plan (SAP), Characterization of the 903 Pad/Ryan's Pit and East Trenches Plume (IT Corp., 1998), and the appropriate RFETS Standard Operating Procedures referenced in the SAP.

The upper strata of unconsolidated sediments in these borings consisted of colluvium of various lithologies, principally silty clays and clayey silts, sometimes containing sand particles. Lenses of coarser, subangular to subrounded sands and gravels were occasionally encountered. Bedrock consists of a grayish-brown massive claystone identified by a lack of coarse-grained material. The claystone varied from moist to very dry, often becoming drier with depth. In places the claystone also contained abundant caliche.

The depth to bedrock varied from 2.6 feet in well 02198 to 18.8 feet in well 01198. The bedrock surface slopes to the southeast, in broad conformance with the surficial topography. Along the line of Geoprobe borings, localized bedrock lows occur at borings 00598, 01298, 01498, and 01698, possibly indicating the presence of south-trending preferential flow pathways (Figure 2-6). A sequence of highly weathered claystone overlying sandy silt also suggests the possibility of a slump block at this location.

Concentrations of VOCs in soils from the 1998 borings are presented in Table 2-2. The analytical results presented in this section are preliminary. Data validation of 25 per cent of the data set by an independent third party subcontractor, as specified in the SAP (IT, 1998b), has not yet been completed. Low concentrations of VOCs, primarily acetone, were detected in several of the borings. The maximum concentration of acetone was 0.072 milligram per kilogram (mg/kg) in boring 01798. The concentrations of acetone are well below action levels. The appearance of acetone in dry boreholes and boreholes away from the plume might be due to laboratory contamination since it is a common cross-contaminant. All other detected VOCs were below the reporting limit, including carbon tetrachloride and trichloroethene in boring 01298 and 1,2,4-trimethylbenzene and naphthalene in boring 02098. The traces of chlorinated VOCs in 01298 soils coincide with the highest groundwater concentrations encountered in this investigation.

Groundwater was encountered in only eight of the 26 wells installed in the study area. The six westernmost wells of the alignment were dry (Figure 2-1). To the east, groundwater was intermittently encountered in the wells with the water table generally occurring within weathered bedrock. The water table slopes to the southeast, in general conformance with surficial and bedrock topography. During measurements made on June 18, 1998, the water table was observed within the colluvium in only three wells marked by locally low bedrock (01298, 01498, and 01698), with approximately three feet or less of saturated colluvium (Figure 2-1). Available data from these wells indicate that contaminated groundwater might eventually discharge to the SID and/or Woman Creek.

Concentrations of VOCs in groundwater observed during the plume characterization investigation are presented in Table 2-3. Concentrations of the major plume constituents (carbon tetrachloride, tetrachloroethene, and trichloroethene) are also plotted in Figure 2-1. Of the six wells that could be sampled, VOCs were detected in five. The VOC concentrations in these five wells exceeded one or more Tier II action levels (MCLs). Tier I action levels (100 times MCLs) were not exceeded in any of the wells. In addition to the three main plume constituents, detected compounds include methylene chloride, chloroform, tetrachloroethene, cis-1,2-dichloroethene, and naphthalene. The plume is bounded on the

18

Table 2-2. Plume Characterization Sampling - Subsurface Soil Contaminants (mg/kg) and Corresponding RFCA Action Levels

Borehole Identification	Sampled Interval (ft bgs)	Water-Level Elevation (feet)	Acetone (mg/kg)	Carbon Tetrachloride (mg/kg)	Trichloroethene (mg/kg)
RFCA Tier I Subsurface Soil Action Level			2,740	11	9.27
00198	14.2 – 14.5	Dry	ND	ND	ND
00298	7.4 – 7.9	Dry	ND	ND	ND
00398	10.6 – 11.4; 14.8	Dry	ND	ND	ND
00498	11.0 – 11.6	Dry	ND	ND	ND
00598	14.0 – 14.6	Dry	ND	ND	ND
00698	13.8 - 14.7	Dry	ND	ND	ND
00798	9.0 – 10.0	Dry	0.007	ND	ND
00898	13.0 – 14.0	Dry	ND	ND	ND
00998	7.3 – 7.8	5850.47	ND	ND	ND
01098	10.0 - 10.9	Dry	ND	ND	ND
01198	16.0 – 17.8	Dry	ND	ND	ND
01298	13.3 – 14.0	5840.43	ND	0.002J	0.005J
01398	4.4 – 6.5	5841.85	ND	ND	ND
01498	5.0 – 5.6	5840.16	ND	ND	ND
01598	6.6 – 7.0	Dry	ND	ND	ND
01698	14.7 – 15.5	5839.79	ND	ND	ND
01798	4.3 – 5.2	5840.18	0.072	ND	ND
01898	3.4 – 4.5	Dry	0.010	ND	ND
01998	2.0 – 2.7	Dry	ND	ND	ND
02098	?	Dry	0.020	ND	ND
02198	4.3 – 4.8	Dry	0.002J	ND	ND
02298	3.3 – 4.2	Dry	ND	ND	ND
03998	3.0 - 4.7	Dry	0.006	ND	ND
04098	4.9 – 5.5	Dry	ND	ND	ND
04198	Not sampled?	Dry	ND	ND	ND
04298	4.0 – 5.1	Dry	ND	ND	ND

J - estimated value, concentration is below the detection limit
ND – not detectable, below the detection limit of 0.006 mg/kg except for borehole 01598 which had a detection limit of 0.005 mg/kg

west end by numerous dry wells and on the east end by several dry wells and one well, 01998, in which VOCs were not detected.

Table 2-3 Plume Characterization Sampling - Volatile Organic Compounds in Groundwater (µg/l)

Analyte (µg/l)	RFCA Tier II Groundwater Action Level (µg/l)	Well Identification Number					
		01298	01398	01498	01698*	01698*	01798
Methylene Chloride	5	24	10	31			
1,1-Dichloroethene	7	3 J					
Chloroform	100	96	7		73	73	32
Carbon Tetrachloride	5	460 E			150	140	13
Trichloroethene	5	500 E	9		42	40	12
Tetrachloroethene	5	0.023			8	7	2 J
Xylene (total)	100						1 J
cis-1,2-Dichloroethene	70	9			5	5	1 J
Naphthalene	1,460		6		3 J		4 J

* = Duplicate Samples
E = concentration exceeds the instrument calibration range and was diluted
J = result is estimated value below reporting limit
Blank Spaces = Not detected at detection limit of 5 ug/L
Note: Table includes only compounds detected in one or more of the samples.

2.4 EVIDENCE OF NATURAL ATTENUATION

Natural attenuation processes include "a variety of physical, chemical, and biological processes that, under favorable conditions, act without human intervention to reduce the mass, toxicity, mobility, volume or concentration of contaminants in soil or groundwater" (EPA, 1997). This might include any or all of the following processes:

- Chemical Transformation,
- Biodegradation,
- Dilution,
- Dispersion,
- Sorption, and
- Volatilization

For the 903 Pad/Ryan's Pit Plume, all of these processes could play key roles in reducing downgradient contaminant concentrations. Physical processes could be as effective as degradation in controlling contaminants. There are a number of potential mechanisms that could degrade or limit the mobility of VOCs in the 903 Pad/Ryan's Pit Plume. For the 903 Pad/Ryan's Pit plume, the determination of a specific mechanism of attenuation is not critical; however, downgradient monitoring of the trends of volatile organic contaminant concentrations is critical to ensure protection of surface water.

2.4.1 Plume Equilibrium

Evidence of natural attenuation could be the low downgradient concentrations encountered during past investigations. The releases that created the plume occurred between 1955 and 1971 (DOE, 1992), approximately 27 to 43 years ago. Since these are relatively older releases, it is possible that the 903 Pad/Ryan's Pit Plume might have had sufficient time to reach steady state conditions. However, Well 01487 which is about 60 feet upgradient of the line of 1998 wells shows an apparent trend of increasing

concentration of carbon tetrachloride and trichloroethene over time (see Figure 2-7). Concentrations of tetrachloroethene are closer to detection limits and appear to have no apparent trend. Based on this gradual increase in concentration, the VOC plume might be moving slowly. The primary factor affecting the downgradient plume is probably not degradation but rather, the effects of permeability and hydraulic gradient in slowing the groundwater flow.

2.4.2 Degradation Products

The presence of degradation products is an important indicator of contaminant-destroying chemical and biological processes. One difficulty in ascertaining the presence of degradation product is that a wide variety of organic solvents appear to have been placed into Ryan's Pit. Expected degradation products could be solvents from the original release. Table 2-4 presents some of the key contaminants for the 903 Pad/Ryan's Pit Plume and their associated degradation products. 1,1,1-Trichloroethane was included in the analysis because it is found in Well 07391 in the Ryan's Pit source area. Concentrations of up to 1,100 ug/l of 1,1,1-Trichloroethane have been detected in the source area; however it does not appear that it is affecting downgradient ground water. Most of the trichloroethene is probably residual solvent from the source area as opposed to a decay product from tetrachloroethene.

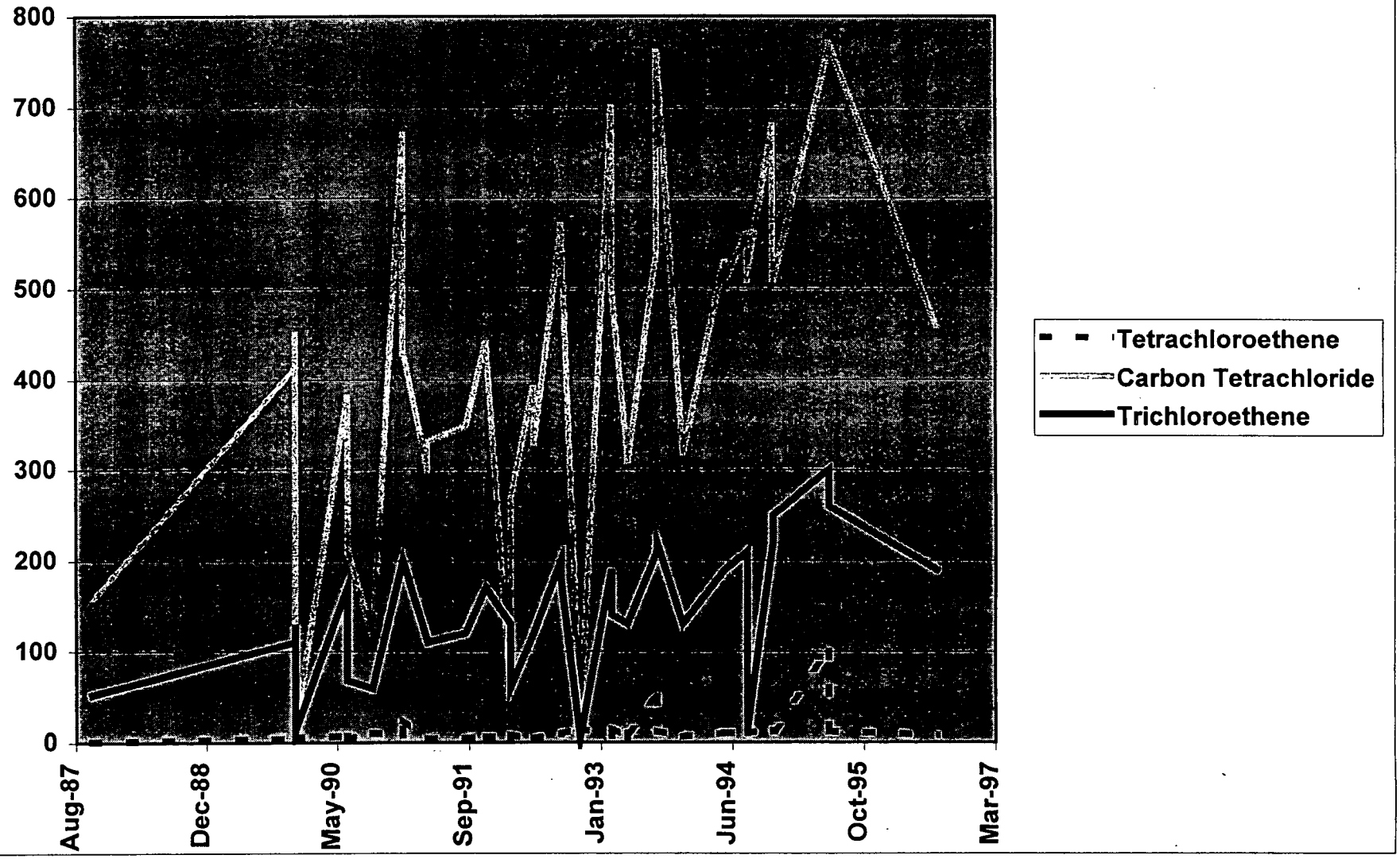
Table 2-4 Key Contaminants and Associated Degradation Products in the 903 Pad/Ryan's Pit Plume

Key Contaminant	Degradation Product	Maximum Concentration in 1998 Downgradient Wells (ug/l) *	Maximum Concentration in Well 01487 (ug/l) (1987-1996)
Carbon Tetrachloride		460	770
	Chloroform	96	55
	Methylene Chloride	31	17
	Chloromethane	Not Detected	Not Detected
1,1,1-Trichloroethane		Not Detected	1.06
	1,1–Dichloroethane	Not Detected	Not Detected
	Chloroethane	Not Detected	Not Detected
Trichloroethene		500	300
	Dichloroethene	9	5
	Vinyl Chloride	Not Detected	Not Detected
Tetrachloroethene		23	15
	Trichloroethene	500	300
	Dichloroethene	9	5
	Vinyl Chloride	Not Detected	Not Detected

* Wells 01298, 01398, 01498, 01698, 01798, and 01998, maximums based on detection in at least two of these wells.

Based on Table 2-4, degradation products for three principal contaminants appear to be present in both locations. The degradation products found are all consistent with hydrogenolysis as a reductive dechlorination reaction. Hydrogenolysis is a destructive hydrogenation reaction where hydrogen replaces the chlorine atom. Although these reaction products are strong indicators of reductive dechlorination, the greater concentrations of the primary VOCs indicates that reductive degradation is not a major factor in limiting the plume movement.

Figure 2-7 VOC Concentration (ug/l) in Well 01487 Versus Time



2.4.3 Hydrogeologic Factors

The main factor limiting the VOC plume extent appears to be site hydrogeology. The area is poorly saturated and the wells at the west end of the study area were dry (Figure 2-1). Groundwater flow is confined to the east side of the study area. Past slumping could be affecting the flow patterns in the study area. Additionally, the bedrock surface is known to have erosional features that will further affect the flow. These subsurface features might have lengthened the flow path of the plume and enhanced attenuation of the plume through physical processes. Figure 2-8 shows the primary flow path for the contaminated groundwater. This area is also characterized by intermittent seeps from both the bedrock and the alluvium. The combination of heterogeneous permeabilities, areas of low permeability and depressions in bedrock could have routed the flow of water to the eastern portion of the study area, farther down the SID, and possibly limited contaminant migration to surface water.

2.4.4 Surface Water Impacts

There is no evidence of surface water impacts from the plume. Based on data in the RFETS Soil and Water Database, VOCs have been sporadically detected in the SID at concentrations less than 100 µg/l. The source of these contaminants cannot be tied into 903 Pad /Ryan's Pit Plume since VOCs have been detected in the SID upstream of the plume. If VOCs are daylighting in the SID, they are likely attenuating on the surface, most likely through volatilization prior to reaching down stream sampling locations. The downstream sampling station located where the SID discharges into C-2 pond which have had methylene chloride at concentrations of 14 µg/l or less and a one-time concentration of 1,1,1-trichloroethane of 0.2 µg/l. Since methylene chloride is a common laboratory contaminant and the principal contaminants and degradation products in groundwater monitoring wells have not appeared in these proximal downstream surface water locations, there is not an evident impact to surface water at this time. Further down slope from the SID, proximal locations in Woman Creek have not historically had any of the principal contaminants or degradation products associated with the 903 Pad/Ryan's Pit Plume.

2.4.5 Conclusions Concerning Natural Attenuation in the 903 Pad/Ryan's Pit Plume

The following conclusions can be made based on existing data:

- Concentrations of contaminants in wells currently at the leading edge of the plume need to be monitored to determine if natural attenuation is occurring, to determine trends in the concentration of VOCs in the groundwater, and to confirm that plume migration is not occurring.

- The presence of reductive dechlorination products of the three major contaminants suggests that small quantities from the original release might have been degraded. The potential degradation products appear to be consistent with the same degradation mechanism, specifically, hydrogenolysis.

- Hydrogeologic processes appear to have a much greater impact on contaminant migration than degradation processes.

- There is no evidence that the 903 Pad/Ryan's Pit Plume is currently impacting surface water at this time.

3.0 PROPOSED ACTION

Based on a review of existing data, RFETS, EPA, and CDPHE determined that downgradient monitoring would be the best approach for 903 Pad/Ryan's Pit Plume (in addition to source removal at the 903 Pad) to address future risk, assess the effects of natural attenuation, and ensure protection of surface water. Monitoring is a cost-effective alternative to groundwater treatment that ensures the protection of surface water. The use of monitoring does not preclude source removal as a long-term remedial measure. Source removal can address the source area contamination and reduce the influx of additional contaminants into the groundwater; however, it is generally ineffective on contaminants that are already in the plume as a dissolved phase and therefore monitoring is needed to provide additional protection.

3.1 PROPOSED APPROACH

The proposed approach for monitoring the 903 Pad/Ryan's Pit plume will be to install three downgradient wells to monitor VOCs. One well will be placed near Well 01298 (Figure 3-1). This location was selected based on mass flux calculations (IT, 1998b) presented in Appendix A. Based on the 1998 well data, this well consistently had the highest contaminant load for each of the chlorinated solvents thus the greatest contaminant mass flux.

Two additional wells will be placed downgradient of the 1998 wells and upgradient of the SID, which is the nearest surface water location. The location of these wells will be determined by using the observational approach, where Geoprobe holes will be placed to determine which locations have the greatest groundwater flow based on saturated thickness, hydraulic gradient, bedrock contours, and other hydrogeological attributes. Figure 3-1 shows the general area where Geoprobe holes will be placed. The flow rate and contaminant flux have already been determined for the temporary 1998 wells (See Appendix A). Prior to performing the fieldwork, an ecological survey will be conducted to ensure that the work does not result in detrimental ecological effects.

Geoprobe locations and permanent wells will only be monitored for VOCs. All activities will be integrated with existing RFETS monitoring activities under the IMP (Kaiser-Hill, 1997). Monitoring is planned to continue until enough data are collected to establish a trend in downgradient concentrations. Further details on data quality objectives, sampling procedures, and chemical analysis will be presented in the as a SAP appendix to the workplan to be developed under the IMP. Monitoring will be initially done quarterly in conjunction with the IMP activities for a year after which is will be done annually. The same sampling and analyses methodologies used for monitoring RFCA groundwater wells will be utilized for the 903 Pad/Ryan's Pit Plume wells. If at any time during monitoring, the monitoring data indicates that the plume could cause surface water concentrations to exceed the RFCA Action Levels in Table 1-1 then the approach to 903 Pad/Ryan's Pit Plume will have to be reevaluated.

3.2 DATA QUALITY OBJECTIVES

The 903 Pad/Ryan's Pit Plume monitoring requirements will be determined using the process in *Guidelines for Data Quality Objective Process*, EPA QA/G4 (EPA, 1994) based on the objectives in Section 1.1. These data quality objectives will be further developed in a sampling and analysis plan (SAP) attachment to the work plan.

After the data are received, the data will be compared to project specific data quality objectives in the workplan. Data validation will be performed on a minimum of 25% of overall site data. The data will be evaluated using the precision, accuracy, reproducibility, completeness, and comparability (PARCC) parameters established by EPA guidelines, and described in the Rocky Mountain Remediation Services (RMRS) Quality Assurance Project Description (QAPD) (RMRS, 1997c).

25

3.3 WORKER HEALTH AND SAFETY

This project falls under the scope of the Occupational Safety and Health Administration (OSHA) construction standard for Hazardous Waste Operations and Emergency Response, 29 Code of Federal Regulations (CFR) 1910.120. Under this standard, the Health and Safety Plan (HASP) currently utilized for groundwater monitoring will be revised to address the safety and health hazards of each phase of monitoring activities and specify the requirements and procedures for employee protection. In addition, the DOE Order for Construction Project Safety and Health Management, 5480.9A, applies to this project. This order requires the preparation of Activity Hazard Analyses (AHAs) to identify each task, the hazards associated with each task, and the precautions necessary to mitigate the hazards. The AHAs will be included in the HASP. This project could expose workers to physical and chemical hazards. Physical hazards include those associated with use of drilling equipment, noise, heat stress, and cold stress. Chemical hazards include exposure to the contaminated groundwater. Physical hazards will be mitigated by engineering controls, administrative controls, and appropriate use of personal protective equipment (PPE). Chemical hazards will be mitigated by the use of PPE and administrative controls. Appropriate skin and respiratory PPE will be worn throughout the project. Routine VOC monitoring will be conducted with an organic vapor monitor.

If unanticipated hazards or conditions are encountered during this project in accordance with RMRS policy (Directive-001), the project activities will pause to assess the potential hazard or condition to determine whether work can proceed with existing safety controls. If field conditions or hazards vary from the planned approach and it is determined that work can be done safely, an AHA will be prepared or modified to address the unexpected circumstances, and work will proceed according to the appropriate control measures. Data and safety controls will be continually evaluated. Field radiological screening will be conducted as appropriate using radiological instruments appropriate to detect surface contamination and airborne radioactivity. As required by 10 CFR 835, Radiation Protection of Occupational Workers, all applicable implementing procedures will be followed to insure protection of the workers, collocated workers, the public, and the environment. The HASP will describe the air monitoring to be used to monitor for radiation, VOCs, and particulate, as appropriate. If necessary, air monitoring will be performed in accordance with applicable procedures, which includes perimeter Radioactive Ambient Air Monitoring Program (RAAMP) monitoring throughout the project duration. Air monitoring activities may vary and are dependent on field activities.

3.4 REMEDIATION WASTE MANAGEMENT

Remediation waste anticipated from drilling and sampling include drill cuttings, purge water, PPE, and development water from well installation. All wastes will be managed in accordance with the RFETS standard operating procedure, Field Operations (FO).29, for IDM under the existing IDM program. Wastes generated, as part of this proposed action, will be characterized based on process knowledge, analytical results, and radiological screening. Based on FO.29, wastes, such as PPE, identified as non-radiological and non-hazardous will be disposed in a sanitary landfill. Purge water will be treated at the 891 Consolidated Water Treatment Facility.

4.0 IMPLEMENTATION SCHEDULE

Installation of downgradient wells will be completed in Fiscal Year 1999. The downgradient monitoring of the 903 Pad/Ryan's Pit Plume is scheduled to commence in the fiscal year 1999 on a quarterly basis. Monitoring will be reduced to an annual basis after one year of quarterly samples.

5.0 REFERENCES

DOE, 1992, Historical Release Report for the Rocky Flats Plant, June.

DOE, 1995, *Phase II RCRA RFI/CERCLA RI Report, 903 Pad, Mound, and East Trenches Area, OU 2*

DOE, 1996, *Final Rocky Flats Cleanup Agreement*, Rocky Flats Environmental Technology Site, Golden, Colorado, July.

DOE 1997, *Rocky Flats Cleanup Agreement, Appendix 3, Final RFCA Implementation Guidance Document*, Rocky Flats Environmental Technology Site, Golden, Colorado, August.

EG&G, 1995, *Hydrogeologic Characterization Report for the Rocky Flats Environmental Technology Site, Volume II of the Sitewide Geoscience Characterization Study* April.

EPA, 1994, *Guidelines for Data Quality Objective Process*, EPA QA/G-4, Draft Final, March.

EPA, 1997, *Use of Monitored Natural Attenuation At Superfund, RCRA Corrective Action, and Underground Storage Sites*, OSWER Directive 9200.4-17, U.S. Environmental Protection Agency Office of Solid Waste and Emergency Response, Washington, D.C., November.

IT Corp., 1998, *Sampling and Analysis Plan, Characterization of the 903 Pad/Ryan's Pit and East Trenches Plumes*

Kaiser-Hill, 1997, *Rocky Flats Environmental Technology Site Integrated Monitoring Plan FY-97*, Kaiser-Hill Company, December.

RMRS 1996, Analysis of Vertical Migration Potential, RF/ER-96-0040.UN.

RMRS, 1997a, *Closeout Report for the Remediation of Individual Hazardous Substance Site 109, Ryan's Pit*, RF-ER-96-0034.UN, Revision 0, July.

RMRS, 1997b, 1996 *Annual Rocky Flats Cleanup Agreement (RFCA) Groundwater Monitoring Report for Rocky Flats Environmental Technology Site*, RF/RMRS-97-087.UN, November.

RMRS, 1997c, *Quality Assurance Project Description*, RMRS-QAPD-001, Revision 1, January.

Appendix A

Estimate of Contaminant Flux

903 Pad/Ryan's Pit Plum

By ZHT Date 7/15/98 Subject Estimation of Contaminant Flux
Chkd By Date 903 Pad/Ryan's Pit Plume, RFETS

PURPOSE:
Estimate the flux of contaminants from the distal, downgradient portion of the 903 Pad/Ryan's Pit Plume potentially entering surface water in the Woman Creek drainage.

METHODOLOGY:
The alignment of push-probe wells installed in 1998 north of Woman Creek and the South Interceptor Ditch forms the basis of the estimate. All groundwater on the steep south-facing slope above the elevation of the creek bed is assumed to discharge to the surface via seeps.

Transmissivity and concentrations in those wells within the distal portion of the plume are used to calculate the average contaminant loads in colluvium and weathered bedrock. Together with hydraulic conductivity and the length of the plume perpendicular to its flow direction, the flux of the contaminant VOCs are calculated.

ASSUMPTIONS:

In the lower portion of the Woman Creek drainage, groundwater flows horizontally out of colluvium and weathered bedrock, discharging to the surface water system. Discharge from bedrock is assumed to be limited to the first 10 feet of saturated bedrock, or the full saturated thickness between top of saturated bedrock and the creekbed elevation along a given point's downgradient flowpath, whichever is greater.

VOC plume concentrations are uniform vertically through the colluvium and weathered bedrock.

The horizontal hydraulic gradient is uniform through the plume along the alignment, and is uniform vertically through colluvium and weathered bedrock.

The following geometric means of hydrogeologic units within RFETS are assumed to be representative:

Colluvium	9.3E-05 cm/sec	2.6E-01 ft/day
Weathered claystone bedrock	8.8E-07 cm/sec	2.5E-03 ft/day

Loss or destruction of contaminants through evapotranspiration, biodegradation, and other processes is not considered. All contaminants at the alignment of the push-probe wells are conservatively assumed to enter the surface water drainage.

CALCULATIONS:
See following sheets.

CONCLUSIONS:
Flow and contaminant flux in the weathered bedrock is negligible. The colluvium is inconsistently saturated, and the distal portion of the plume transmits little flow and contaminants to the Woman Creek drainage.

Well	Elevation above MSL (feet) 6/18/98 Groundwater	Top of Bedrock	Creekbed on Flowpath	Saturated Thickness Colluvium (ft)	Bedrock Type [1]	Saturated Thickness Bedrock (ft) [2]	Transmissivity Colluvium sq.ft./day	Transmissivity Bedrock sq.ft./day	
01298	5840.43	5837.5	5834	2.90	CS	10.0	7.6E-01	2.5E-02	
01398	5841.85	5844.1	5832	0.00	CS	10.0	0.0E+00	2.5E-02	In
01498	5840.16	5839.9	5828	0.20	CS	11.9	5.3E-02	3.0E-02	Plume
01698	5839.79	5836.6	5822	3.20	CS	14.6	8.4E-01	3.6E-02	
01798	5840.18	5841.9	5821	0.00	CS	19.2	0.0E+00	4.8E-02	
						In-Plume Average T	3.3E-01	3.3E-02	

dh/dl = 0.053 Horizontal hydraulic gradient, from 6/18/98 groundwater elevations in wells 1487, 01398, 01498
L = 400 ft Estimated plume length, perpendicular to flow.

Q = KA(dh/dl)
Q = TL(dh/dl) Using average in-plume Transmissivity (T) values above:

	Flow in cu.ft./day Colluvium	Bedrock	Total
Q =	7.0	0.69	7.7

Average groundwater velocities (v) within plume:
v= K(dh/dl)/n where effective porosity n is assumed to be 0.1.

	Velocity in ft./day Colluvium	Bedrock
v =	0.14	0.0013

	Colluvium	Bedrock
Time (years) to travel 350 feet (distance on flowpath from 01298 to creek =	6.9	725.2

Footnotes:
1 Bedrock type: CS = Weathered claystone (encountered in all alignment borings)
2 Saturated bedrock thickness considered is 7 feet (consistent with practicable depth of barrier emplacement).

32

Well	RIN	Event	Bottle	Concentration in ug/L Methylene Chloride	1,1-Dichloroethene	Chloroform	Carbon Tetrachloride	Trichloroethene	Tetrachloroethene	cis-1-2-Dichloroethene	Napthalene	
01298	98A1951	002	001	24	3	98	460	500	23	9	U	
01398	98A2143	004	002	10	U	7	U	9	U	U	6	In
01498	98A1951	003	001	31	U	U	U	U	U	U	U	Plume
01698	98A2143	002	002	U	U	73	150	42	U	U	3	
01798	98A2143	003	002	U	U	32	13	12	U	U	4	
01998	98A2143	001	002	U	U	U	U	U	U	U	U	

Well	RIN	Event	Bottle	Tier I (100 times MCL) and Tier II (1 times MCL) Action Level Exceedances (MCLs are shown immediately below) 5 Methylene Chloride	7 1,1-Dichloroethene	100 Chloroform	5 Carbon Tetrachloride	5 Trichloroethene	5 Tetrachloroethene	70 cis-1-2-Dichloroethene	#N/A Napthalene	
01298	98A1951	002	001	>1x	<	<	>1x	>1x	>1x	<		
01398	98A2143	004	002	>1x	--	<	--	>1x	--	--		In
01498	98A1951	003	001	>1x	--	--	--	--	--	--		Plume
01698	98A2143	002	002	--	--	<	>1x	>1x	--	--		
01798	98A2143	003	002	--	--	<	>1x	>1x	--	--		
01998	98A2143	001	002	--	--	--	--	--	--	--		

Note: The plume extent, as defined above, incorporates all exceedances of Tier II action levels along the alignment.

				Colluvium Contaminant Load in g/day/ft								
Well	RIN	Event	Bottle	Methylene Chloride	1,1-Dichloroethene	Chloroform	Carbon Tetrachloride	Trichloroethene	Tetrachloroethene	cis-1-2-Dichloroethene	Napthalene	Total VOCs
01298	98A1951	002	001	5.2E-04	6.5E-05	2.1E-03	1.0E-02	1.1E-02	5.0E-04	1.9E-04	0.0E+00	2.4E-02
01398	98A2143	004	002	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
01498	98A1951	003	001	4.6E-05	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.6E-05
01698	98A2143	002	002	0.0E+00	0.0E+00	1.7E-03	3.6E-03	1.0E-03	0.0E+00	0.0E+00	7.2E-05	6.4E-03
01798	98A2143	003	002	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Average				1.1E-04	1.3E-05	7.6E-04	2.7E-03	2.4E-03	1.0E-04	3.9E-05	1.4E-05	6.1E-03

				Bedrock Contaminant Load in g/day/ft								
Well	RIN	Event	Bottle	Methylene Chloride	1,1-Dichloroethene	Chloroform	Carbon Tetrachloride	Trichloroethene	Tetrachloroethene	cis-1-2-Dichloroethene	Napthalene	Total VOCs
01298	98A1951	002	001	1.7E-05	2.1E-06	6.8E-05	3.3E-04	3.5E-04	1.6E-05	6.4E-06	0.0E+00	7.9E-04
01398	98A2143	004	002	7.1E-06	0.0E+00	4.9E-06	0.0E+00	6.4E-06	0.0E+00	0.0E+00	4.2E-06	2.3E-05
01498	98A1951	003	001	2.6E-05	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.6E-05
01698	98A2143	002	002	0.0E+00	0.0E+00	7.5E-05	1.5E-04	4.3E-05	0.0E+00	0.0E+00	3.1E-06	2.8E-04
01798	98A2143	003	002	0.0E+00	0.0E+00	4.3E-05	1.8E-05	1.6E-05	0.0E+00	0.0E+00	5.4E-06	8.3E-05
Average				1.0E-05	4.2E-07	3.8E-05	9.9E-05	8.4E-05	3.3E-06	1.3E-06	2.6E-06	2.4E-04

				Total Contaminant Load in g/day/ft								
Well	RIN	Event	Bottle	Methylene Chloride	1,1-Dichloroethene	Chloroform	Carbon Tetrachloride	Trichloroethene	Tetrachloroethene	cis-1-2-Dichloroethene	Napthalene	Total VOCs
01298	98A1951	002	001	5.4E-04	6.7E-05	2.1E-03	1.0E-02	1.1E-02	5.1E-04	2.0E-04	0.0E+00	2.5E-02
01398	98A2143	004	002	7.1E-06	0.0E+00	4.9E-06	0.0E+00	6.4E-06	0.0E+00	0.0E+00	4.2E-06	2.3E-05
01498	98A1951	003	001	7.2E-05	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	7.2E-05
01698	98A2143	002	002	0.0E+00	0.0E+00	1.8E-03	3.7E-03	1.0E-03	0.0E+00	0.0E+00	7.5E-05	6.7E-03
01798	98A2143	003	002	0.0E+00	0.0E+00	4.3E-05	1.8E-05	1.6E-05	0.0E+00	0.0E+00	5.4E-06	8.3E-05
Average				1.2E-04	1.3E-05	8.0E-04	2.8E-03	2.4E-03	1.0E-04	4.0E-05	1.7E-05	6.4E-03

X = TC g/day/ft Contaminant load equals transmissivity times concentration
Unit conversion: T(sq.ft/day) x C (ug/L) x 28.32 L/cu.ft x 10-6 g/ug =TC (g/(day/ft)
T is taken from the values calculated for both colluvium and bedrock at individual wells on the "Flow" sheet
C is from the table of concentrations on the "Concentration" sheet

Contaminant Flux
903 Pad/Ryan's Pit Plume

	Contaminant Flux in g/day								
	Methylene Chloride	1,1-Dichloroethene	Chloroform	Carbon Tetrachloride	Trichloroethene	Tetrachloroethene	cis-1-2-Dichloroethene	Napthalene	Total VOCs
Colluvium	2.4E-03	2.8E-04	1.6E-02	5.7E-02	5.0E-02	2.1E-03	8.3E-04	3.0E-04	1.3E-01
Bedrock	2.1E-04	9.0E-06	8.1E-04	2.1E-03	1.8E-03	6.9E-05	2.7E-05	5.4E-05	5.1E-03
Total	2.6E-03	2.8E-04	1.7E-02	6.0E-02	5.2E-02	2.2E-03	8.5E-04	3.6E-04	1.3E-01

F = Q C — Contaminant Flux equals flow times concentration

F = [TL(dh/dl)]C

F = XL(dh/dl) — Contaminant Flux equals Contaminant Load times Length times hydraulic gradient

dh/dl = 0.053 — Horizontal hydraulic gradient, from 6/18/98 groundwater elevations in wells 1487, 01398, 01498

L = 400 ft — Estimated plume length, perpendicular to flow.

X is taken from the average values calculated for colluvium and bedrock on the "Load" sheet

REVIEW COMMENT SHEET

Please review the attached procedure: RF/ER-98-294.UN (Number) 0 (Rev.) X (Draft) Draft Technical Memorandum Monitoring of the 903 Pad/Ryan's Pit Plume (Title)

Comment Due Date: _____

☐ Internal Review ☐ Parallel Review ☐ Verification ☐ Validation ☐ Revalidation

QA X Peer ____

General (G) comments require resolution but do not require resolution acceptance. Mandatory (M) comments require resolution and resolution acceptance. 1-88000-PP-004 provides complete definitions of General and Mandatory comments.

ITEM G or M	PAGE	SECTION OR STEP	COMMENT	RESOLUTION	Resolution accepted INIT/DATE
G	1 of 22	1.1	Verify that the RFCA is the current version - the IGD was updated this year.	Recent controlled copies are dated 1996	JGD 12/10/98
M	1 of 22	1.1	Include the RFCA Tier I/II action levels for surface water.	The RFCA action levels were added for the principal contaminants.	JGD 12/10/98
M	1 of 22	1.2	Include the depths of the proposed wells.	Corrected	JGD 12/10/98
G	5 of 22	2.3	2nd sentence, replace "designed" with implemented.	Corrected	JGD 12/10/98
G	5 of 22	2.3	3rd paragraph, last sentence, insert a space after 2-4.	Corrected	JGD 12/10/98
M	11 of 22	2.3	6th paragraph, Clarify the 3rd sentence.	Corrected	JGD 12/10/98
M	15 of 22	2.4.1	1st sentence delet "shows" and include the chemical name for the plouw.	Corrected	JGD 12/10/98
G	15 of 22	2.4.2	Insert a ",", after Well 07391	Corrected	JGD 12/10/98

POC/Reviewer: (Comments not signed by Reviewer/POC will be considered unofficial and not subject to resolution)

☐ No Comments

☐ This procedure revision has no impact or relevance to our discipline or organization and we waive need to concur. We acknowledge this concurrence waiver does not affect our responsibility to implement the requirements of this procedure when needed.

Greg DiGregorio (Name) Greg DiGregorio (Signature)

5688, 212-6206 (Ext./Pager/Fax) T893B/QA (Bldg./Dept.) 12/9/98 (Date)

Return to:

____ (FAX) ____ (Name) X (Ext.) ____ (Location)

If questions on content, please call the SME:

____ (Name) ____ (Ext.)

36

REVIEW COMMENT SHEET (continued)

Review comments for document: Draft Tech Memo Monitoring of the 903 Pad/Ryan's Pit Plume (Title) 0 (Rev.) X (Draft)

ITEM G or M	PAGE	SECTION OR STEP	COMMENT	RESOLUTION	Resolution accepted INIT/DATE
G	17 of 22	2.4.3	Reference Figure 2-1 in the 2nd sentence.	Corrected	GDD 12/10/98
G	18 of 22	3.0	Delete the second period from the 1st sentence.	Corrected	GDD 12/10/98
M	18 of 22	3.1	3rd paragraph - How will the monitoring be implemented for this work and what actions will be taken when concentrations of chemicals increase? Please specify.	Corrected	GDD 12/10/98
M	18 of 22	3.2	Clarify the 2nd paragraph. 1st sentence should reference the SAP The second sentence needs to be modified to evaluate the PARCC parameters.	Corrected	GDD 12/10/98
M	18 of 22	3.2	Are the DQOs the same for these wells as identified in the SAP? If so, please reference the SAP and particular section. If not, then include the specific DQOs for these wells.	Specific DQOs will be put in the SAP attachment to the workplan	GDD 12/10/98

POC/Reviewer: (Comments not signed by the Reviewer/POC will be considered as unofficial comments)

Greg DiGregorio (Name) — Greg DiGregorio (Signature) — 12/9/98 (Date)

Resolutions Accepted

GDD (Initials) — 12/10/98 (Date)

37/37

Figure 1-1
903 Pad/Ryan's Pit
Plume Location Map

IHSS 112
903 PAD

Ryan's Pit

EXPLANATION

Standard Map Features

- Buildings and other structures
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Paved roads
- Dirt roads

DATA SOURCE:
Buildings, fences, hydrography, roads and other structures from 1994 aerial fly-over data captured by EG&G RSI, Las Vegas.
Digitized from the orthophotographs, 1/95

Scale = 1 : 2600
1 inch represents approximately 217 feet

0 100 200 Feet

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

U.S. Department of Energy

Rocky Flats Environmental Technology Site

Prepared by:

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Rocky Mountain Remediation Services, L.L.C.
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Rocky Flats Environmental Technology Site
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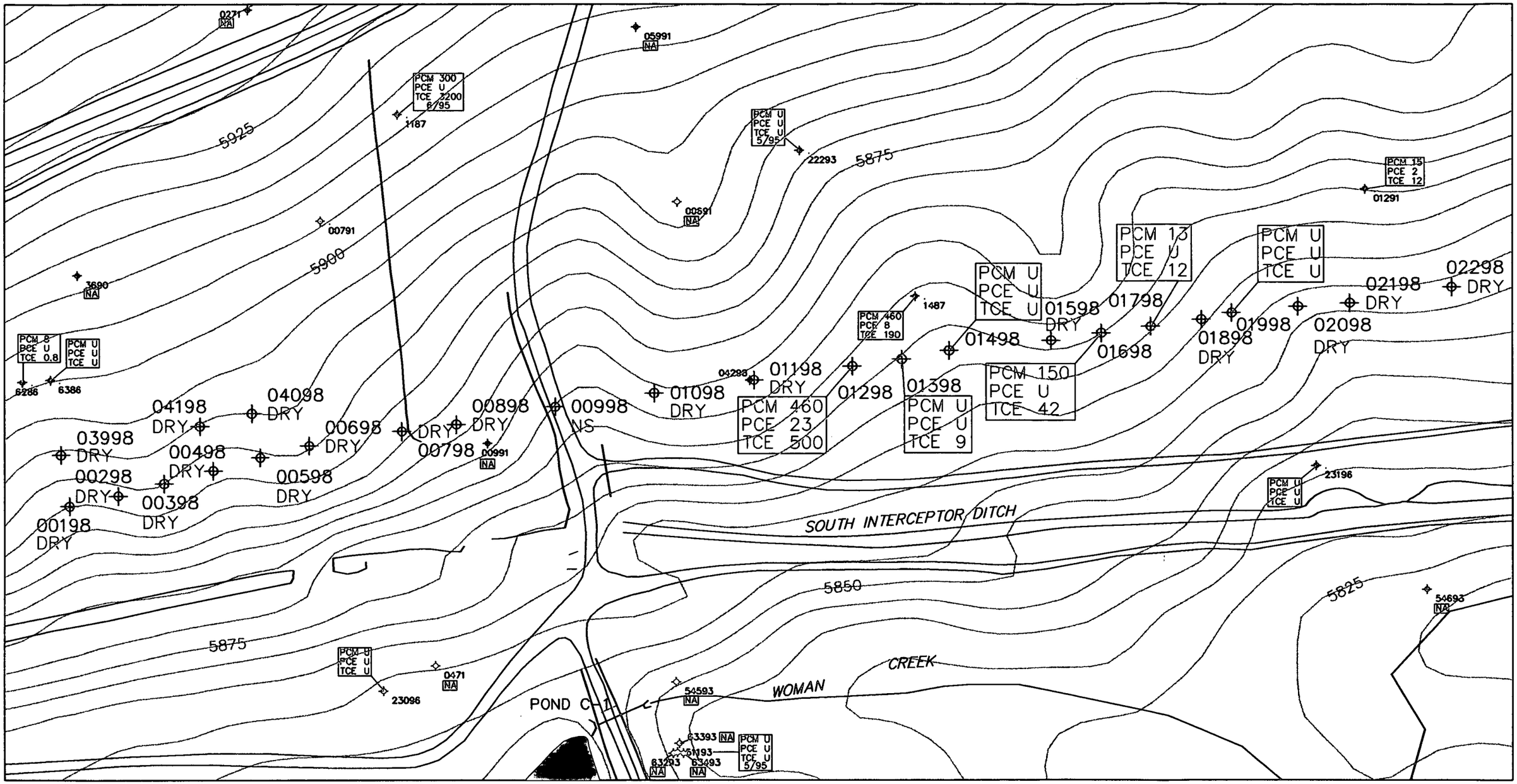
MAP ID: 98-0066

December 07, 1998

/gis2/projects/fy98/98-0066/ryans-pit_loc.aml



LEGEND

- LAKES AND PONDS
- STREAMS AND DITCHES
- 5 FOOT CONTOUR
- FENCE OR OTHER BARRIER
- DIRT ROAD
- 00898 — SAMPLED WELL LOCATION (INSTALLED 1998)
- 00991 — EXISTING DATA LOCATION

GRAPHIC SCALE
0 25 50 100
(IN FEET)
1 inch = 100 ft.

PCM 8
PCE U
TCE 0.8

VOC CONCENTRATIONS IN GROUNDWATER, 1996 MAXIMUM (RMRS, 1997b), OR LATEST AVAILABLE ANALYSIS (MONTH/YEAR SHOWN), ug/L

NOTE: PCM = CARBON TETRACHLORIDE (PERCHLORMETHANE)
PCE = TETRACHLOROETHENE (PERCHLOROETHYLENE)
TCE = TRICHLOROETHENE
U = NOT DETECTED
NA = NO ANALYSIS AVAILABLE
DRY=NOT SAMPLED (NO WATER)
NS=NOT SAMPLED (INSUFFICIENT WATER)

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Golden, Colorado

FIGURE 2-1

TITLE:
VOC's IN GROUNDWATER
AT THE 903 PAD/RYAN'S PIT
PLUME STUDY AREA

PROJ. NO.	774115	DWG. NO.	4115B013	SHEET 6
DESIGN BY	ZT	CHECKED		OF 6
DRAWN BY	JDL	APPROVED		
DATE	6-26-98	SCALE	1:100	

99-0066/figure2-1

Figure 2-2
Trichloroethene Concentration in Groundwater, 1991-1997 (Avg.)

EXPLANATION

Trichloroethene concentration equal to or greater than 5 ug/L

Trichloroethene concentration equal to or greater than 500 ug/L

Trichloroethene Concentration (ug/L)

- Undetected
- 0 - 0.5
- 0.5 - 1
- 1 - 5
- 5 - 100
- 100 - 500
- > 500

- Alluvial Wells
- Bedrock Wells
- Alluvial/Bedrock Wells

Standard Map Features

- Buildings and other structures
- Solar evaporation ponds
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Contour (20-Foot)
- Paved roads
- Dirt roads

DATA SOURCE:
Buildings, fences, hydrography, roads and other structures from 1994 aerial fly-over data captured by ESRI RSI, Las Vegas.
Digitized from the orthophotographs, 1/94
Topography (contours) were derived from digital elevation model (DEM) data by Morrison Knudsen EMG using ESRI Arc TIN and LATTICE to process the DEM data to create 2-foot contours.
The DEM data was captured by the Remote Sensing Lab, Las Vegas, NV, 1994 Aerial Flyover at ~ 10 meter resolution.
The DEM post-processing performed by MK, Winter 1997.

NOTE:
Tier 2 Action Level = 5 ug/L
Tier 1 Action Level = 500 ug/L
Note: 19 values above Tier 1 Action Level

Scale = 1 : 2300
1 inch represents approximately 192 feet

0 100 200ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

U.S. Department of Energy

Rocky Flats Environmental Technology Site

Prepared by:

RMRS Rocky Mountain Remediation Services, L.L.C.
Geographic Information Systems Group
Rocky Flats Environmental Technology Site
P.O. Box 464
Golden, CO 80402-0464

MAP ID: 98-0056 December 08, 1998

/gis2/projects/by98/98-0056/ac_be_plume.ami

Figure 2-3
Carbon Tetrachloride Concentration in Groundwater
1991-1997 (Avg.)

EXPLANATION

- Carbon Tetrachloride concentration equal to or greater than 5 ug/L
- Carbon Tetrachloride concentration equal to or greater than 500 ug/L

Carbon Tetrachloride Concentration (ug/L)

- Undetected
- 0 - 0.5
- 0.5 - 1
- 1 - 5
- 5 - 100
- 100 - 500
- > 500
- Alluvial Wells
- Bedrock Wells
- Alluvial/Bedrock Wells

Standard Map Features

- Buildings and other structures
- Solar evaporation ponds
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Contour (20-Foot)
- Paved roads
- Dirt roads

DATA SOURCE:
Buildings, fences, hydrography, roads and other structures from 1994 aerial flyover data captured by EG&G RSI, Las Vegas.
Digitized from the orthophotographs 1/95
Topology (contours) were derived from digital elevation model (DEM) data by Harrison Grubbon IMRO using ESRI Arc TIN and LATTICE to process the DEM data to create 1-Foot contours.
The DEM data was capture by the Pacific Eastship Co, Las Vegas, NV, 1994 Aerial Flyover at ~ 10 meter resolution.
The DEM post-processing performed by IMC, Winter 1997.

NOTE:
Tier 2 Action Level = 5 ug/L
Tier 1 Action Level = 500 ug/L

Note: 22 values above Tier 1 Action Level

Scale = 1 : 2300
1 inch represents approximately 192 feet

0 100 200 Feet

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

U.S. Department of Energy

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Prepared by:

RMRS Rocky Mountain Remediation Services, L.L.C.
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P.O. Box 464
Golden, CO 80402-0464

MAP ID: 98-0068 December 05, 1998

/gis2/projects/hydro/98-0068/ac_oct4_plum.aml

15

Figure 2-4

Tetrachloroethene Concentration in Groundwater, 1991-1997 (Avg.)

EXPLANATION

- Tetrachloroethene concentration equal to or greater than 5 ug/L
- Tetrachloroethene concentration equal to or greater than 500 ug/L

Tetrachloroethene Concentration (ug/L)

- Undetected
- 0 - 0.5
- 0.5 - 1
- 1 - 5
- 5 - 100
- 100 - 500
- > 500
- Alluvial Wells
- Bedrock Wells
- Alluvial/Bedrock Wells

Standard Map Features

- Buildings and other structures
- Solar evaporation ponds
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Contour (20-Foot)
- Rocky Flats boundary
- Paved roads
- Dirt roads

DATA SOURCE:
Buildings, fences, hydrography, roads and other structures from 1994 aerial fly-over data captured by ESRI / RSI, Las Vegas.
Digitized from the orthophotographs. 1/95 Topology (contours) were derived from digital elevation model (DEM) data by Morrison Knudsen (MK) using ESRI Arc TIN and LATTICE to process the DEM data to create 5-foot contours. The DEM data was capture by the Remote Sensing Lab, Las Vegas, NV, 1994 Aerial Flyover at ~ 10 meter resolution. The DEM post-processing performed by MK, Winter 1997.

NOTE:
Tier 2 Action Level = 5 ug/L
Tier 1 Action Level = 500 ug/L

Note: 18 values above Tier 1 Action Level

N

Scale = 1 : 2200
1 inch represents approximately 192 feet

0 100 200 400 Feet

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Prepared by:
RMRS
Rocky Mountain Remediation Services, L.L.C.
Geographic Information Systems Group
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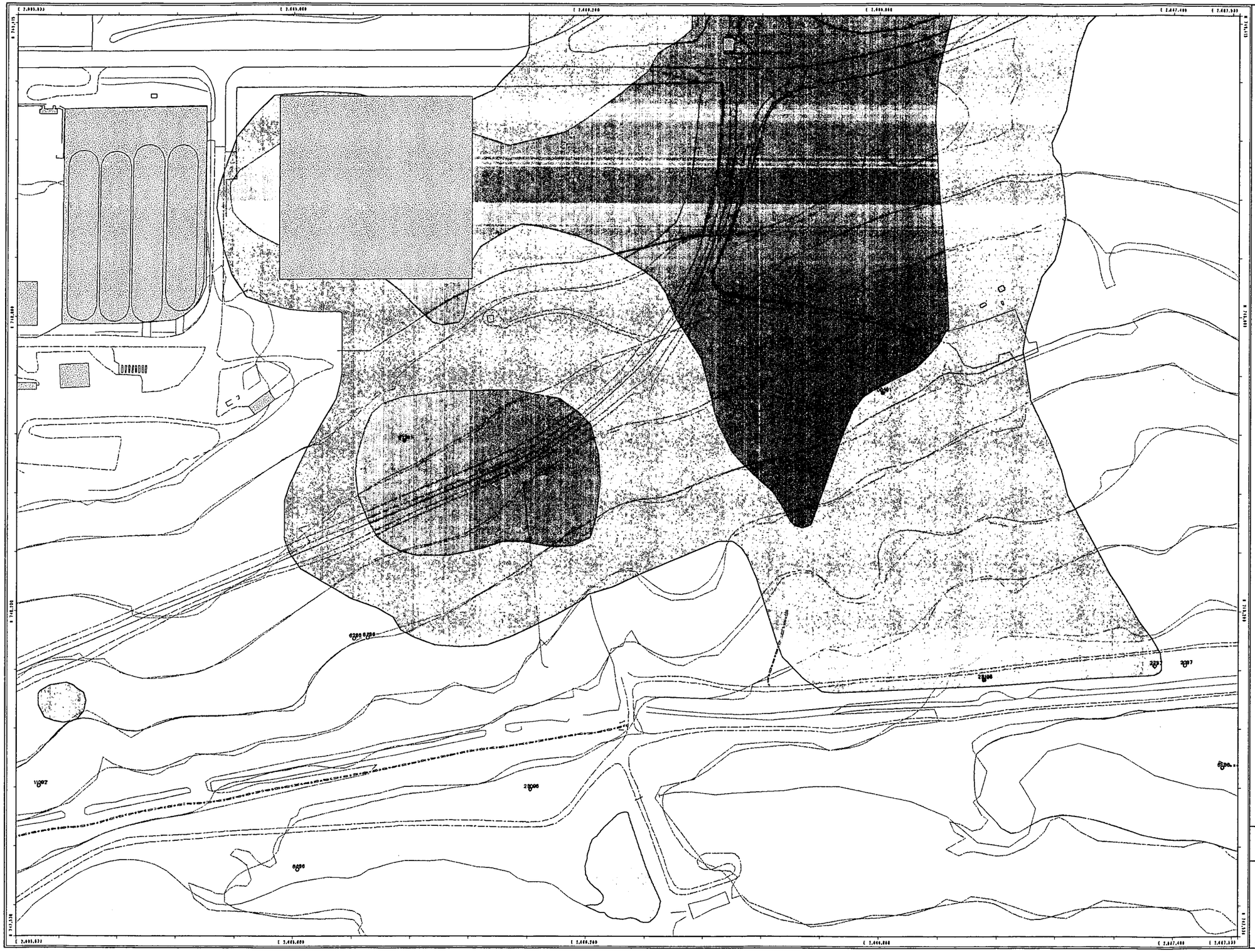
Golden, CO 80402-0464

MAP ID: 99-0066 December 08, 1998

/gis2/projects/fy99/99-0066/ks_pce_plume.aml

16

Figure 2-5
Plate 20
VOC Composite Plume Map



EXPLANATION

- Composite VOC Groundwater Plume (100 X MCL)
- Composite VOC Groundwater Plume (concentration equal to MCL)
- IMP Water Quality Monitoring Wells

Standard Map Features

- Buildings and other structures
- Solar evaporation ponds
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Contour (20-Foot)
- Rocky Flats boundary
- Paved roads
- Dirt roads

DATA SOURCE:
Buildings, fences, hydrography, roads and other structures from 1994 aerial flyover data captured by EG&G RSC, Las Vegas.
Digitized from the orthophotographs. 1/20 Topography (contours) were derived from digital elevation model (DEM) data by Montrose Goodson (MT) using ESRI Arc TIN and LATTICE to process the DEM data to create 5-foot contours.
The DEM data was captured by the Remote Sensing Lab, Las Vegas, NV, 1994 Aerial Flyover at ~ 30 meter resolution.
The DEM post-processing performed by MTK, Winter 1997.

Scale = 1 : 2320
1 inch represents approximately 194 feet

50 0 100 200ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Prepared by:

RMRS **Rocky Mountain Remediation Services, L.L.C.**
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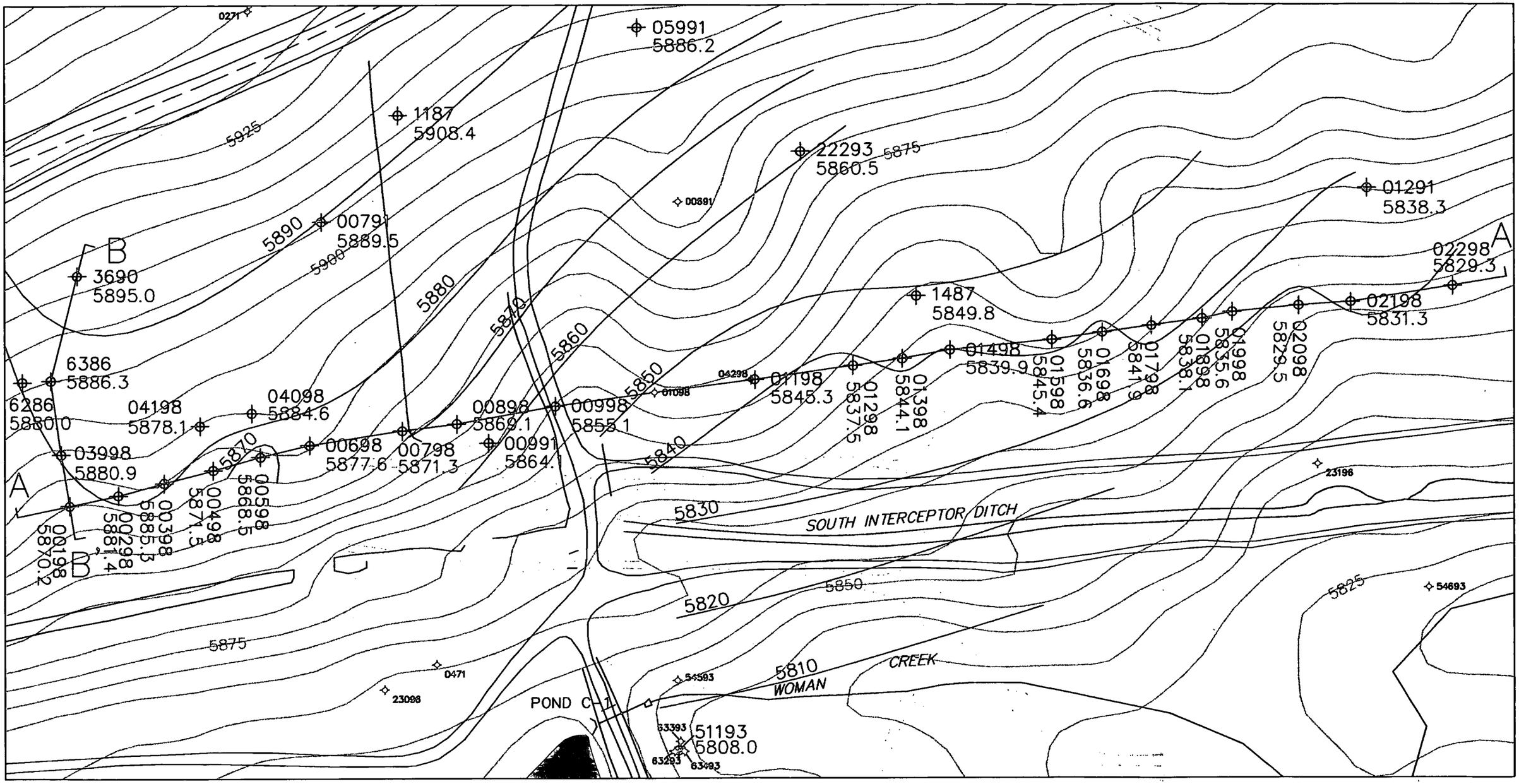
MAP ID: 99-0068 December 08, 1999

/gis2/projects/fy99/99-0068/sec_comp_plm99.aml



LEGEND

- LAKES AND PONDS
- STREAMS AND DITCHES
- FENCE OR OTHER BARRIER
- DIRT ROAD
- 5940 — 5-FOOT SURFACE CONTOUR
- TOP OF BEDROCK ELEVATION CONTOUR
- A — A' HYDROGEOLOGIC CROSS SECTION ALIGNMENT
- 00898 / 5869.1 — WELL LOCATION SHOWING BEDROCK ELEVATION
- 00991 — EXISTING DATA LOCATION

GRAPHIC SCALE
0 25 50 100
(IN FEET)
1 inch = 100 ft.

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Golden, Colorado

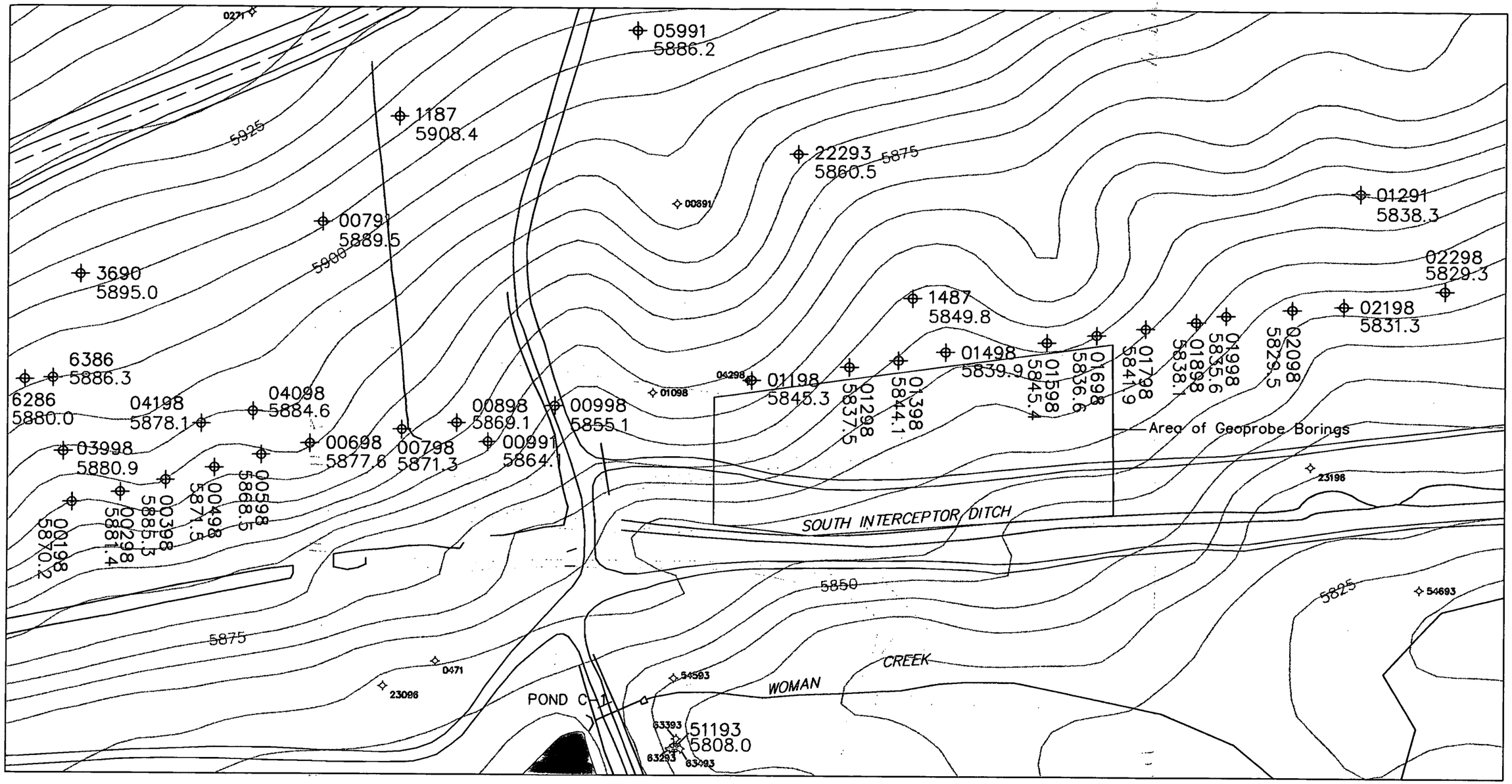
FIGURE 2-6

TITLE: TOP OF BEDROCK MAP IN THE 903 PAD/RYAN'S PIT PLUME STUDY AREA

PROJ. NO.	774115	DWG. NO.	4115B006	SHEET 3 OF 6
DESIGN BY	ZT	CHECKED		
DRAWN BY	JDL	APPROVED		
DATE	6-23-98	SCALE	1:100	

20

99-0960/figure2-6.dwg



LEGEND

- LAKES AND PONDS
- STREAMS AND DITCHES
- FENCE OR OTHER BARRIER
- DIRT ROAD
- 5 FOOT SURFACE CONTOUR
- TOP OF BEDROCK ELEVATION CONTOUR
- HYDROGEOLOGIC CROSS SECTION ALIGNMENT
- 00898 / 5869.1 — WELL LOCATION SHOWING BEDROCK ELEVATION
- 00991 — EXISTING DATA LOCATION

GRAPHIC SCALE
0 25 50 100
(IN FEET)
1 inch = 100 ft.

PREPARED FOR:
ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE
Golden, Colorado

FIGURE 3-1

TITLE:
LOCATION MAP
GEOPROBE BORING

PROJ. NO.	774115	DWG. NO.	4115B006	SHEET 3 OF 6
DESIGN BY	ZT	CHECKED		
DRAWN BY	JDL	APPROVED		
DATE	6-23-98	SCALE	1:100	

9600-66/figure2-6.dwg